**3.2 – Balancing Chemical Reactions**

**Law of Conservation of Mass**

* Matter cannot be created or destroyed, but merely changed, converted or rearranged
* In a chemical reaction, the total mass of the products is equal to that of the reactants entering the reaction – atoms are not created or destroyed, but simply rearranged.
* Therefore, in a chemical reaction, **the chemical formula must be balanced for mass and charge – each side of the equation must have the same number of atoms of each element.**

**Law of Conservation of Energy**

* Similar to the previous law – energy is not created or destroyed, but simply transferred
* For this reason, sometimes we must represent heat in our chemical equations.
* For our purposes, we can simply write “+ heat”. The location will depend on the type of reaction.
* **Exothermic** – heat is written on the product side.
* **Endothermic** – heat is written on the reactant side. For these, heat can also be written above the reaction arrow as “heat” or as “∆”.

**Balancing Reactions!**

* Balancing must be done with coefficients. These are numbers that will appear immediately before the reactant or product. For example, H2O could become 2H2O.
* You can change coefficients to balance, but you can never change subscripts! For example, H2O could **never** be turned into H2O2 in an attempt to balance.

**Tips for Balancing – An Example…**

* Begin with atoms that occur only once on each side of the arrow. For example:

C3H8 + O2 🡪 CO2 + H2O

* It would be very difficult to start with oxygen, since it appears in one reactant, and two products. Use C or H first.

Starting with carbon:

C3H8 + O2 🡪 3CO2 + H2O

Now each side has 3 carbon atoms.

There are 8 hydrogens on one side, and just 2 on the other. So…..

C3H8 + O2 🡪 3CO2 + 4H2O

Now carbon and hydrogen both have even numbers.

Oxygen is left. There are 2 oxygen on the left, and 10 on the right. So…

C3H8 + 5O2 🡪 3CO2 + 4H2O

Now, our reaction is completely balanced.

3 carbon = 3 carbon

8 hydrogen = 8 hydrogen

10 oxygen = 10 oxygen

* For the finished, balanced equation, include states. Our example would look like this:

C3H8(g) + 5O2(g) 🡪 3CO2(g) + 4H2O(l)

It might help to draw a small table when balancing. In our example, it could have looked like this:

|  |  |  |
| --- | --- | --- |
|  | Reactants | Products |
| C | 3 | 1 |
| H | 8 | 2 |
| O | 2 | 3 |

From here, you can change each number in the table as you work through the problem.

* Balancing is a skill that takes practice! You may easily understand the concept of it, but in order to become good at it, you will need to spend some time working at it.
* Let’s get to it then!